

Environmental Effects Report

ML & LM House Fahey's Lane Quarry Lake Mikany

Fahey's Lane, Lake Mikany, Irishtown

SUPPLEMENT

November 2012



Prepared by

Environmental Service and Design Pty Ltd

ABN 97 107 517 144 ACN 107 517 144

Office

14 Cattley Street
Burnie TAS 7320
Phone: (03) 6431 2999
Fax : (03) 6431 2933
www.esandd.com.au

Postal

PO Box 651
Burnie TAS 7320

Project No. 4686

Document Control

Prepared & Published by: ES&D
Version: Final
File:
Contact: Rod Cooper
Phone No: (03) 6431 2999
Prepared For: MJ & LM House

Version:	Reviewed/Approved By	Date
Final	Gillian Rasmussen	28/11/2012
Reviewed by:	Rod Cooper	29/11/2012

This report has been prepared, based on information generated by Environmental Service and Design Pty Ltd from a wide range of sources. If you believe that Environmental Service and Design Pty Ltd has misrepresented or overlooked any relevant information, it is your responsibility to bring this to the attention of Environmental Service and Design Pty Ltd before implementing any of the report's recommendations.

In preparing this report, we have relied on information supplied to Environmental Service and Design Pty Ltd, which, where reasonable, Environmental Service and Design Pty Ltd has assumed to be correct. Whilst all reasonable efforts have been made to substantiate such information, no responsibility will be accepted if the information is incorrect or inaccurate.

This report is prepared solely for the use of the client to whom it is addressed and Environmental Service and Design Pty Ltd will not accept any responsibility for third parties.

In the event that any advice or other services rendered by Environmental Service and Design Pty Ltd constitute a supply of services to a consumer under the Trade Practices Act 1974 (as amended), then Environmental Service and Design Pty Ltd's liability for any breach of any conditions or warranties implied under the Act shall not be excluded but will be limited to the cost of having the advice or services supplied again.

Nothing in this Disclaimer affects any rights or remedies to which you may be entitled under the Trade Practices Act 1974 (as amended).

Each paragraph of this disclaimer shall be deemed to be separate and severable from each other. If any paragraph is found to be illegal, prohibited or unenforceable, then this shall not invalidate any other paragraphs

Contents

Document Control	1
Foreword	3
Erratum	3
1 Introduction	4
1.1 Government Agency Comments Pertaining to the EER.....	4
1.2 Document Construction	5
2 Acid and Metalliferous Drainage	5
3 Karst Systems.....	6
4 Amended Table of Commitments	6
5 Noise.....	8
6 Amended Risk Assessment	12
Appendix 1	16

Foreword

This document addresses all comments received from State Government agencies and bodies in relation to the Environmental Effects Report (EER) for the Permit Application (DA12/97) for a proposed quarry at Fahey's Lane, Irishtown (July 2012). The public submission period began on October 10, 2012. No public representations were received during the public comment period.

The Supplement provides the information required to allow the assessment process for the quarry to be completed, and, as such, should be included in any reading of the EER.

Erratum

Section 3.3, Page 25 and Section 3.7, Page 31 (Table 1) of the EER states that monitoring of the settlement pond will occur monthly, however this is an error; monitoring will occur weekly as per Appendix 7 and the Table of Commitments (Commitment 7(a)).

1 Introduction

The proposed project that is the subject of the EER to which this Supplement relates is an extension of an existing Extractive Industry Level 1: Fahey's Lane, Irishtown, approved by Circular Head Council (DA2008/00034, dated 21 November 2008). The current approval is for extraction within an existing Mining Lease (1882P/M) of no more than 5,000 cubic metres of material per annum. The proposed project is an extension of the existing quarrying operation in both production and area. The EER was submitted in October, 2012 as part of the approval process for the extension proposal. The EPA, acting under delegation and in accordance with 27I(1) of the *Environmental Management and Pollution Control Act 1994*, has indicated that a Supplement to the EER must be prepared as the result of a number of comments relating to the EER received from State Government agencies and bodies during the public submission period.

1.1 Government Agency Comments Pertaining to the EER

A Summary of Comments on the project was constructed by the EPA and provided to the proponent. The summary of comments, together with the information required to address the comments, was provided in table format, reproduced below (Table 1).

Table 1		
Issue	Comment	Additional Information Required
Acid and Metalliferous Drainage (AMD)	The risk evaluation of AMD has not been included in the risk table. The risk of encountering potentially acid forming (PAF) rock could impact on community water supply, potential habitats and the viability of the activity.	It is recommended that a re-evaluation of the risk of AMD from the operation of the activity be carried out including: Inclusion of AMD in the risk table. All commitments made in the EER and Appendices should be listed and discussed in the relevant sections of the EER. Address the potential for karst systems to occur in the area including proposed management and contingencies.
	Commitments made in Appendix 7 – Geotechnical Assessment, have not been included as commitments in the main body of the EER.	
	AMD arising from quarrying has been recognized by the geological survey as a potential impact. The main risk from AMD is that runoff may affect water supply, threatened vegetation communities and threatened fauna habitat. It is recommended that these impacts are included in the risk assessment and that management actions are adequately outlined.	
	The presence of Black River Dolomite implies potential for karstic development. While this is not a highly karstic formation, any karst features encountered should be protected from further disturbance pending assessment by a karst expert.	
	Identifying potentially acid forming (PAF) rocks is difficult until after the acidification process has begun (red staining). Therefore, there is the possibility that PAF containing materials may be in the extracted material to be used in road/cow lane construction where the acidification process will continue until fully oxidized.	
Noise	The statement "Trucks will only use exhaust brakes along Fahey's Lane to lower the noise pollution" is not correct. The determination of noise levels from machinery in the EER shows a lack of understanding of the technical aspects of noise.	It is recommended that a re-evaluation of the noise aspects for the proposal be carried out.

1.2 Document Construction

Within this Supplement, each of the agency comments is addressed under headings related to “Issue” and “Comment” as per Table 1, and comment made with reference to amendments in respect of the EER. AMD is addressed in Section 2, Karst Systems in Section 3, and Noise in Section 5.

Sections of the EER requiring amendment as a result of comments in Section 1.1 are as follows:

- EER Part D – Management Commitments (changes have been highlighted in bold text)
- EER Appendix 4 - Risk Table

Amended EER documents are provided in the Supplement in Sections 4 and 6 respectively.

2 Acid and Metalliferous Drainage

Additional information required:

a) Re-evaluate the risk of AMD from the operation of the activity. Include AMD in the risk table.

- see amended risk table (Section 6)

b) Commitments made in EER Appendix 7 – *Geotechnical Assessment* have not been included in the main body of the EER. All commitments made in the EER and Appendices should be listed and discussed in the relevant sections of the EER.

- Appendix 7 includes an extensive discussion on acid mine drainage and provides a plan for its management and prevention, including an ongoing monitoring plan and associated commitments. The plan was also extensively discussed in Section 3.7 (pp. 29-31 incl.) of the EER main document, and a commitment to monitor AMD was listed at the bottom of page 31 (Commitment 7). Direction of run-off and discharge is discussed in Section 2.2 (p. 12) and Section 3.3 (p. 25), but note Erratum with respect to Section 3.3. The commitment on page 31 is intended to trigger appropriate actions with respect to the commitments related to AMD made in Appendix 7. However, in the interests of clarity, each of the commitments contained in Appendix 7, but omitted from the basal margins of the pages and the table of commitments in the EER, has now been encompassed in the amended Management Commitments table (Section 3) as Commitment 7(b).

c) Identifying potentially acid forming (PAF) rocks is difficult until after the acidification process has begun (red staining). Therefore, there is the possibility that PAF containing materials may be in the extracted material to be used in road/cow lane construction where the acidification process will continue until fully oxidized.

- There are potential impacts from AMD with respect to sediments that may be encountered with increasing extraction depth, however, a monitoring and management plan has been put in place to deal with this. In the current extraction area, the PAF exists only in localized areas but not in any great quantity. Furthermore, the proponent is aware of the location of PAF material and will not extract in its vicinity. The proponent is experienced in dealing with PAF rocks; he is the operator of another quarry in the area where PAF rocks are evident. In that quarry, PAF material is not extracted due to its physical properties; it is readily identifiable by virtue of the fact that it is very difficult to handle (“slushy” by nature) and is consequently not used. (Simon House *pers. comm.* 16/11/12). The proponent gives the following further commitments:

C7 (c) Stop mining if PAF rocks are inadvertently exposed (treatment plan implemented as per Commitment 7(b)).

C7 (d) PAF rocks will not be used as farm road base; will not be removed from the site.

The table of commitments has been updated to reflect these changes (Section 4).

3 Karst Systems

(d) The presence of Black River Dolomite implies potential for karstic development. While this is not a highly karstic formation, any karst features encountered should be protected from further disturbance pending assessment by a karst expert.

- A further commitment is made:

C21 If karst features are encountered extraction will cease in the area, assessment will be sought from a karst expert, and a management plan developed, if required.

4 Amended Table of Commitments

Subject	Commitment	Page Number	Person Responsible	Forecast completion
C1.Flora	An exclusion area and buffer zone along the minor creeks and Deep Creek which extend through the eastern and south-eastern and the northern portion of the land will be established and maintained.	21	M. House	At Approval
C2. Eagle management	An eagle management plan will be implemented.	21	M. House	Ongoing
C3.Sediment pond	The capacity in the pond and retention time will be monitored as the work rate intensifies and the pond size increased if necessary.	25	M. House	Quarterly
C4. Dust	When dust is likely to be a problem, a water truck will be on standby to wet down the processing and traffic areas to minimize adverse effects.	28	M. House	During high wind events
C5. Surface water	Maintenance of settling ponds will be periodically undertaken to ensure adequate function of the ponds as silt traps.	29	M. House	Ongoing
C6. Surface water	Hydrocarbon spill kits are maintained on site for use if significant quantities of hydrocarbons are lost from plant or equipment.	29	M. House	Already stored

C7. Acid mine drainage	(a) To monitor the pH of the surface water leaving the site weekly when inflow is occurring, maintain results and submit to EPA at 6-monthly intervals. If the pH drops below 6 contact the consultant within 24 hours.	31 and Appendix 7	M. House	Weekly/ six monthly
	(b) To execute the commitments made in Appendix 7 to the management of AMD.	Appendix 7		Ongoing
	(c) Stop mining if PAF rocks are inadvertently exposed; implement treatment plan as per Commitment 7(b).	EER Supplement		As encountered
	(d) PAF rocks will not be used as farm road base; will not be removed from the site.	EER Supplement		Ongoing
C8. Solid Waste	The stockpiled topsoil materials will be used to progressively rehabilitate the site.	32	M. House	Ongoing
C9. Scrap waste	All scrap metal or other recyclable materials will be stored on site until sufficient quantities are available to warrant collection for recycle.	32	M. House	Already performed
C10. Putrescible waste	All putrescible waste from site will be removed for proper disposal.	32	M. House	Already performed
C11. Noise	(a) Trucks will not use exhaust brakes along Fahey's Lane and a speed limit of 40km/hr will be imposed on trucks using the road on quarry business.	33, EER Supplement	M. House	Ongoing
	(b) Plant will be maintained to limit elevated noise emissions.	EER Supplement	M. House	Ongoing
	(c) Material that is not considered to have acid forming potential will be placed to provide an earth embankment between the quarry and Lake Mikany.	EER Supplement	M House	At Approval
C12. Noise	Operating hours will be between 0700 to 1900 hours, Monday to Friday and 0800 to 1600 on Saturdays.	33	M. House	Already performed
C13. Noise	The quarry will be developed in accordance with the prescribed mining and operations plan in order	33	M. House	Ongoing

	to contain and deflect excess noise from operations to within the amphitheatre to be formed by the quarry faces.			
C14. Traffic	The sight triangle to the north of Fahey's Lane/Gravel Pit Access Road junction will be kept clear of vegetation.	34	M. House	At approval
C15. Traffic	"Truck Entering" warning signs will be installed on Fahey's Lane either side of this junction.	34	M. House	At approval
C16. Traffic	The road verge on the quarry access road will be widened.	34	M. House	At approval
C17. Weeds	Implementation of a weed management plan.	36	M. House	At approval
C18. <i>Phytophthora</i>	Implementation of a <i>Phytophthora</i> management plan.	36	M. House	At approval
C19. Rehabilitation	Progressive re-vegetation and re-introduction of topsoil to the site will be performed in accordance with the mining plan.	36	M. House	Progressive
C20. Review	Unless otherwise specified by the Board of the EPA, monitoring and review of performance will be undertaken on at least an annual basis for the first 3 years, with the aim of extending the period of review subject to satisfactory performance.	37	M. House	Annual for first 3 years.
C21. Karsts	If karst features are encountered extraction will cease in the area, an assessment will be sought from a karst expert and a management plan developed, if required.	EER Supplement	M. House	As required

5 Noise

(e) It is recommended that a re-evaluation of the noise aspects for the proposal be carried out.

- A re-evaluation was conducted by Noise Specialist Dr Steve Carter of Environmental Dynamics (Dr Carter's curriculum vitae is attached in Appendix 1). Changes to commitments as a result of the re-evaluation are highlighted in bold text below and in the amended Table of Commitments:

C11 (a) (formerly Commitment 11) is now revised to impose a speed limit to mitigate noise (and dust), and prevent the use of exhaust brakes on Fahey's Lane.

C11 (b) Plant are maintained to avoid elevated noise emissions.

C11 (c) Material that is not considered to have acid forming potential will be placed to provide an earth embankment between the quarry and Lake Mikany, progressively reducing the noise impact of quarry noise on the eagle nests.

The following comprises the re-evaluation and replaces Section 3.9 of the EER:

Noise Emission

Estimated sound power level of quarry equipment

A Caterpillar D9 dozer is used to prepare the loose gravel, which is then placed into a truck/trailer by a Caterpillar 950 wheel loader. There is, and will be, no rock blasting, screening or crushing on site. These plants are very similar to the D8 dozer and Hyundai HL757-7A wheel loader that operate at the nearby Purdy's Quarry owned by Allan Lord Holdings. L_{eq} noise levels were measured in early 2012 for both these plants as they moved a short distance back and forward to work a stockpile, with the sound level meter at a distance of 32 m from the average location of the plant.

The Hyundai wheel loader and D8 dozer L_{eq} noise levels at 32 m were 64 and 73 dBA respectively, with a background L_{eq} noise level of 33 dBA. Assuming isotropic hemispheric spreading of the sound emissions, and total reflection by the ground, the wheel loader and dozer sound power levels were estimated to be 105 and 114 dBA respectively.

The specifications for a Caterpillar 950 wheel loader state that its sound power level is 106 dBA, confirming its similarity to the Hyundai wheel loader, while D8 and D9 dozers have essentially the same noise emissions. When the 950 wheel loader and D8 dozer are both operating, the noise emissions are therefore dominated by the D8 dozer ($105.0 + 114.0 \approx 114.5$ dBA), with noise from a truck/trailer engine while idling being negligible.

A total quarry plant sound power level of $L_w \approx 115$ dBA is thus assumed for this study, which corresponds to a total sound pressure level of about 84 dBA at 10 m.

Noise impact at nearest residence

The proposed increase in quarry production will result in the facility becoming a Level 2 operation under Tasmania's *Environmental Management and Pollution Control Act (1994)*, regulated by the Environment Protection Authority (EPA) through an operating permit that may include conditions relating to noise emissions. The EPA's approach to regulating industrial noise is guided by its *Environment Protection Policy (Noise) 2009*, and the NSW *Industrial Noise Policy (2000)* is also a useful reference.

A typical quarry noise permit condition would specify the acceptable day-time (7 am to 6 pm) noise level to be 50 dBA, for residences in rural areas. In unusual situations, EPA may require an industrial facility to comply with a very stringent day-time noise level limit of 45 dBA, but this EER assumes that EPA will consider that a day-time quarry noise level limit of 50 dBA is appropriate for the nearest residence, located about 1 km south of the middle of the quarry. Important points are that:

- a) the noise level limit refers only to noise from on-site quarry operations, not the total noise level at the residence;
- b) on calm days, it is possible that noise levels at the residence due to the quarry operations will comply with this assumed permit condition, but still be audible from time to time; and

- c) the measured or predicted noise level at the residence must be adjusted if the noise emissions contain intrusive, or “attention-grabbing” characteristics.

Table 2 shows the variation of predicted Leq (dBA) noise levels with distance from the quarry equipment, for a sound power level of 115 dBA. The predicted noise attenuation due to spreading of the sound assumes flat and totally reflective ground. The additional predicted noise attenuation due to absorption of sound energy by the atmosphere assumes worst case (i.e. least effective) conditions of 90% relative humidity and 10°C.

Table 2: Predicted variation of noise level with distance from quarry for a plant sound power of 115 dBA.

Distance (m) from quarry plant	Noise level (dBA) after	
	a) Flat-terrain spreading	b) Spreading and air absorption
500 m	50.0	47.5
750 m	46.5	43.0
1000 m	44.0	39.7

The predicted noise levels given in Table 2 need to be adjusted if the quarry noise is characterised by intrusive noise characteristics, such as tonality or impulsive noise. In the absence of L₁ and 1/3rd octave band noise level measurements, and field observations regarding frequency and duration of any such characteristics, it is expected that any adjustment would be no greater than 5 dB. Noise level analysis procedures allow for a total adjustment of up to 10 dB, but this is unusual.

The predicted noise levels given in Table 2 also need to be adjusted to account for noise attenuation by terrain and vegetation. Quarry plant are naturally located in a depression, and there is also elevated terrain between the quarry and the nearest residence to the south. The corresponding noise attenuation will almost certainly be greater than the 5 dB penalty adjustment for intrusive noise.

The distance from the quarry plant to the nearest residence will change as the quarry is developed, but will be between the 750 m and 1,000 m distances considered in Table 2.

It is concluded that the quarry plant noise levels will easily comply with even a very stringent day-time noise level limit of 45 dBA, when the D8 dozer is operating. At other times, noise emissions from the wheel loader and a truck/trailer will be some 9 dB lower than when the dozer is working. This conclusion also assumes that plant are maintained to avoid elevated noise emissions due to, say, poor exhaust systems.

Noise impact at eagle nests

The presence of active eagle nests near this quarry complicates the situation. In 2011, EPA issued an Environment Protection Notice (EPN) that required a noise impact assessment be carried out for Purdy’s quarry on the west side of Lake Mikany, that required noise mitigation measures to be implemented if quarry operations produced a noise level of 45 dBA or more at an eagle nest; or if noise with disturbing characteristics is audible at an eagle nest. This EPN is problematic, in that the A-weighting filter is designed for humans, not for eagles, and dB linear noise levels are likely more appropriate; quarry workers report that eagles are disturbed by people approaching a nest, but not by noise; and the 45 dBA noise level does not seem to have any scientific justification.

The eagle nests are reported to be more than 500 m north-west of the quarry. Table 2 shows that noise levels at this distance will be about 47 dBA, plus a possible penalty adjustment for intrusive noise. However, a detailed study would also likely apply noise attenuation corrections for terrain breaking the line of sight between plant and nests and also a vegetation correction (a rule-of-thumb is that a 5 dB correction can be applied for a substantial vegetation screen, at least 30 m wide, with undergrowth).

A desk-top study is not able to make a more accurate prediction, but three points are important, and together argue against the need for a more detailed study. First, the noise emissions from the quarry plant will not increase when the quarry production increases, so there will be no increase in noise impact with respect to the present situation. Second, the noise emissions from greater truck usage of the access road will increase, but the first point is still valid, because the sound power of a truck is much less than the sound power of a D8 dozer, and the access road is further from the quarry. Third, the quarry's development will produce overburden; material that is not considered to have acid forming potential will be placed to provide an earth embankment between the quarry and Lake Mikany, progressively reducing the noise impact of quarry noise on the eagle nests.

Noise emissions from vehicles

Noise limits specified by EPA in permit conditions generally relate to noise emitted from the activity on the site, and do not apply to noise from vehicles travelling on the site access road (Dr Bill Wilson, EPA, pers. comm.). However, noise (and dust) nuisance from haulage trucks can be minimised by introducing a low speed limit (40 km/h) for these vehicles on Faheys Lane, and prohibiting the use of exhaust brakes.

6 Amended Risk Assessment

Amended risk table follows:

Aspect/Hazard	Activity	Probability	Consequence	Inherent Risk	Controls	Probability	Consequence	Residual Risk
Acid Mine Drainage	Exposure of PAF rocks during excavation; Encountering PAF sediments at depth	Known to occur	Minor	High	No extraction in the vicinity of PAF; Direction of runoff to a single discharge point; Weekly monitoring of discharge point; Implementation of AMD Management Plan (as per Appendix 7 of EER)	Not likely to occur	Minor	Low
Fuel and oils	Fire during equipment operation	Known to occur	Minor	High	Fire extinguishers; Maintenance of plant and equipment	Not likely to occur	Minor	Low
Fuel and oils	Release of hydrocarbons during operation or breakdown	Known to occur	Minor	High	No storage of bulk materials on site; Maintenance of plant and equipment; Waste management plans	Not likely to occur	Minor	Low
Erosion	Erosion of stockpiles, batters and banks	Not likely to occur	Minor	Low	Vegetation allowed to establish on top soil stockpiles	Rare	Minor	Low
Solids in discharge	Operation of quarry	Known to occur	Minor	High	Sediment collection sump; Progressive rehabilitation	Not likely to occur	Minor	Low
Flooding	Inundation of excavation	Not likely to occur	Minor	Low	Diversions around pit	Rare	Minor	Low
Traffic	Vehicle accident during haulage of products or other materials	Could occur	Major	High	Speed limits; Vehicle maintenance; TIR modifications;	Not likely to occur	Major	High

Rockfall	Injury due to fall of ground during excavation	Not likely to occur	Moderate	Moderate	Security fence; Batters	Rare	Moderate	Moderate
Dust	Emission of dust from site during operation	Known to occur	Minor	High	Ground water springs; Water cart	Could occur	Minor	Moderate
Noise	Generation of noise during mining, processing and haulage	Known to occur	Minor	Moderate	In-pit operation shielded by rock faces; Restricted operating hours; Isolated location	Not likely to occur	Minor	Low
Flora and fauna	Spread of weeds through ground disturbance	Known to occur	Moderate	High	Weed control activities	Not likely to occur	Moderate	Low
Flora and fauna	Impact on endangered species	Known to occur	Moderate	High	Periodic review of compliance	Not likely to occur	Moderate	Low
Waste materials	Operation of quarry generating waste materials	Known to occur	Minor	High	Waste management includes use of all quarried materials; All putrescible waste taken to council landfill; Beneficial reuse of materials	Not likely to occur	Minor	Low
Visual impacts	Operation of quarry creating visual impact	Could occur	Minor	Moderate	Natural relief screen; Vegetation screens	Not likely to occur	Minor	Low

Consequence								
Insignificant	Minor	Moderate	Major	Catastrophic				
Injury and Disease - S								
Report Only. No treatment required.	First Aid Injury	Medical Treatment Injury or Lost Time Injury	Extensive injuries, permanent part disability	Fatality(s) or permanent serious disability(s).				
Environmental effects E								
No discernable impact or measurable impairment - for example, not exceeding published guideline values for "normal" or "background" levels. Internally reported	Minor effects on biological or physical environment. Minor short-medium term damage to a localized area or that ceases once the event is over.	Measurable impairment on biological or physical environment but not affecting ecosystem function. Short-medium term impacts, where the ecosystem will recover quickly and without intervention.	Serious environmental effects with some impairment of ecosystem function. Relatively widespread medium-long term impacts, requiring remediation, where ecosystem will recover over time once clean-up has been completed.	Very serious environmental effects with significant impairment of ecosystem function. Long term, widespread effects. Remediation required.				
Environment Legal - L								
Unlikely to result in adverse regulatory response or action.	Minor non-compliances and breaches of regulation or consent conditions. Not likely to result in regulatory action, may result in Infringement Notice. Incident reportable to regulatory authorities.	Serious breach of regulation or consent conditions with potential for regulatory action such as issuance of a formal notice, a fine or prosecution.	Major breach of regulation or consent condition that is expected to attract regulatory attention. Investigation, prosecution and/or major fine possible.	May be considered 'willful' or 'negligent' by regulator. Significant prosecution and fines likely. May result in significant litigation, including class actions. May jeopardise future approvals.				
Stakeholder/media interest - M								
Little or no stakeholder interest	Minor, adverse local public or media attention and complaints. Reputation is adversely affected with a small number of site-focused people.	Attention from local media and/or heightened concern by local community. Criticism by NGOs. Environment credentials moderately affected.	Significant adverse national media/public/NGO attention. Environment/management credentials are significantly tarnished.	Serious public or media outcry (international coverage). Damaging NGO campaign. Licence to operate threatened, or may jeopardise future approvals. Reputation severely tarnished. Share price may be affected.				
Total Estimated Cost - C								
<AUS \$5000	AUS \$5000 to \$50,000	AUS \$50,000 to \$500,000	AUS \$500 000 to \$5M	>AUS \$5 million				
Likelihood								
Likelihood	Description	Frequency	Consequence					
Almost Certain	Common repeating occurrence	Daily	Frequency	Insignificant	Minor	Moderate	Major	Catastrophic
Likely	Known to occur	Monthly	Almost Certain	Moderate	High	Extreme	Extreme	Extreme
Possible	Could occur	Yearly	Likely	Moderate	High	High	Extreme	Extreme
Unlikely	Not likely to occur	Once in 10 years	Possible	Low	Moderate	High	High	Extreme
Rare	Practically impossible	Less than once per 10 years	Unlikely	Low	Low	Moderate	High	Extreme
			Rare	Low	Low	Moderate	High	High

Appendix 1

Curriculum Vitae Dr Steve Carter, FIEAust, CPEng

- QUALIFICATIONS** BSc Civil Engineering, University of Manchester
BSc (Hons) Physics, University of Toronto
PhD Engineering, University of Tasmania
PhD Astrophysics, University of Tasmania
- AWARDS** 1995 and 2003 Engineering Excellence Awards
- AFFILIATIONS** Engineers Australia (Fellow)
National Professional Engineers Register (Environmental)
Engineers Australia Tasmania division president 1999-2000
Professional Engineers Ontario, Canada (Member, 1987-1999)
EA National Committee on Environmental Engineering, 1993-96
Australian Meteorological and Oceanographic Society, 1992-96 (chair 1994)
- EXPERTISE** Steve has carried out hundreds of environmental projects for industrial and other clients, particularly in the fields of air quality and dispersion modelling, and noise impact assessment and mitigation work. Steve is also an artificial intelligence specialist, and he has worked with the Murray Darling Basin Authority and others to pioneer environmental applications of expert systems and neural networks. He is an Honorary Research Associate of the University of Tasmania.
- WORK HISTORY**
- 1994 to present** **Environmental Dynamics, Hobart**
Consulting environmental engineering & science practice.
- 1994 - 2007** **Part-time lecturer, School of Engineering, University of Tasmania**
Taught environmental engineering, fluid mechanics, and numerical methods. Contributed to other courses. Supervised 2 PhD and 2 Masters students.
- 1991-94** **Principal Environmental Engineer, SEMF, Hobart**
Established firm's environmental services.
- 1988-91** **Environmental Engineer, Hatch Associates, Toronto**
Member of a 40-strong environmental engineering group. Carried out projects for industrial clients in Canada and the United States.
- 1984-87** **Junior Engineer, MEP Company, Toronto**
Oceanographic and atmospheric models and studies.
- 1981-84** **Junior Engineer / Technician**
Junior structural engineer, Weisman Consultants, Toronto.
Geotechnical technician, BBT Geotechnical Consultants, Edmonton.
- 1979-81** Part-time work in Bristol, U.K; and Haute-Savoie, France.
- CONTACT** Environmental Dynamics
6 Gourlay Street
West Hobart TAS 7000
(03) 6231 0500
steven.carter@utas.edu.au